

**Recommendations:**

- (1) The screws attaching the junction box and gasket should remain intact to keep moisture from the electrical connections inside.
- (2) Excessive build-up on motor will reduce the ability to dissipate heat through air cooling fans.
- (3) If bearings are not permanently sealed tight, they should be greased regularly. Caution should be taken to avoid over greasing.
- (4) Recommend that the gear box shaft key and motor shaft key be cut as follows: Proper Key Length = Original Key Length + Width of Hub/2. Example: If the gear box arrived with a 6" long key & the gear box side hub is 3 1/2" wide, the proper key length is  $6" + 3 \frac{1}{2}"/2 = 4 \frac{3}{4}"$ .
- (5) If metal drive shaft and fan is 28 ft or greater, it has been documented that the drive shaft will bow slightly when stopped in direct sunlight.
- (6) The shaft guards should be attached firmly to the mechanical equipment support to be able to contain the shaft if it comes loose on either side.

Bolt Diameter (in.)	Torque Value (foot-pounds)	
	Galvanized Lubricated	Stainless Steel Lubricated
1/2"	80	40
5/8"	160	80
3/4"	280	140
7/8"	450	225
1"	680	340
1 1/8"	970	485
1 1/4"	1360	680
1 1/2"	2370	1185

- (8) The oil line should be of a non-corrosive material such as stainless steel, copper or brass.
- (9) After installing the oil line, fill the oil in the box to the proper level by checking the oil site gauge on the side of the gearbox. Mark this level on the exterior gauge as the stopped or still level. Then with the fan on, mark the gauge as the operating level. Note - the oil level will go down approximately an inch during operation.
- (10) Vent lines must be piped down beside the gear box and outside the fan stack so the air drawn in is not the hot, moist air of the plenum. Note - if the breather line collects water inside, it will lead to a reading error on the oil fill gauge.
- (11) In storing a gear box for any length of time, prior to or between operations, it should be filled to the top with oil. Normal oil level in operating gear boxes is approximately half full. This is very important - many new gears have been damaged after warehousing because the output bearings were allowed to dry and failed at start-up. DO NOT START gear boxes without draining to operating level - damage will occur and oil will blow the gear box seals.
- (12) Neoprene or stainless steel edge protectors, glued or stainless steel rivets, not screwed.
- (13) Tip clearance shall not be less than 1". This applies for every blade anywhere within the fan stack. Maximum clearance in inches may be calculated by multiplying 0.05 times the fan diameter in feet. Example:  $24' \text{ fan} = 24 \times 0.05 = 1.2"$  (min. 1", max 1.2").
- (14) Blade angle tolerance is to be +/- 0.2° as measured by an approved digital protractor.
- (15) The allowable difference, in inches, in elevation of the blade tip in the fan stack between the lowest to the highest blade.

Fan Diameter	Track
6' - 14'	1/2"
16' - 32'	3/4"
34' - 40'	1 1/2"

- (16) Each time the fan passes over an obstruction, the fan blade momentarily unloads due to the disruption of airflow. If the number of times this occurs matches the natural frequency of the fan or the tower, a severe and sometimes damaging vibration problem will be created.



# Cooling Tower Mechanical Equipment Maintenance

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### **Mechanical Equipment in Mechanical Draft Cooling Towers**

- Electric Motor - Single speed, two speed, variable speed.
- Coupling or Drive Shaft Assembly - connect motor to gear box (assumes right angle configuration).
- Gear Box - Converts motor speed into fan speed
- Fan - Mechanism that draws air up through the tower.

### **Mechanical Equipment - Electric Motor Maintenance**

#### **Electric Motor**

- Usually outside the fan stack, to keep electric products out of corrosive, humid conditions inside the fan stack.
- Junction boxes designed to remain waterproof and corrosion resistant. (1)
- Motor should be kept free excessive accumulation of scale or other debris. (2)
- Bearings on the motors should be kept in good condition. (3)
- For alignment, a minimum of one shim (0.0005 thick) shall be used under each foot of the motor.
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### **Mechanical Equipment - Drive Shaft Maintenance**

#### **Drive Shaft (4) (5)**

- Must transmit torque, accommodate misalignment, and not be subject to vibrations from blade pass frequency or critical speed.
- Shaft Guards - a minimum of two. (6)
- Monitor and inspect hub hardware.
- Determine misalignment or improper clearance, the drive shaft can be turned slowly by hand:
  - \* Distortion of the disk pack or flex element remains constant in its position, than a problem is misalignment between the gear and the motor.
  - \* Deformation of the disk packs or flex element rotates as the drive shaft is turned, then the problem is improper end clearance.



### **Mechanical Equipment - Gear Box Maintenance**

#### **Gear Box**

- Device to reduce speed from motor speed to fan speed.
- Usually right angle design (horizontal input to vertical output).
- Follow recommended torque values when installing a replacement gear reducer. (7)
- Oil fill line should extend from the bottom of the casing to outside the fan shroud to an oil gauge. Oil level should be checked regularly. (8) (9)
- Too much corrosion can insulate the gear casing and force internal temperature rise.
- Frequent change of gear oil recommended.
- Inspect vent lines. (10)
- Spare gear box long term storage. (11)



### **Mechanical Equipment - Fan Maintenance**

#### **Fan**

- Device that draws air up through the tower to create air/water interaction for cooling effect.
- Leading edge protection. (12)
- Throat hardware.
- Tip clearance. (13)
- Blade angle. (14)
- Blade tracking. (15)
- Fan obstructions beneath the fan. (16)

